

AMENDMENTS TO THE CLAIMS

1. (Currently amended) An optical amplifier for amplifying, at once, multiplexed signal light belonging to a predetermined wavelength band, in which a plurality of signal light components having different wavelengths are multiplexed, comprising:

one or a plurality of optical amplification sections each of which has an optical waveguide doped with a fluorescent material and amplifies the multiplexed signal light by optical pumping of the fluorescent material;

~~an~~ optical pumping light ~~source~~ sources for supplying predetermined optical pumping light to said optical amplification section(s);

an optical filter capable of changing a gradient $dL/d\lambda$ of a loss L (dB) with respect to a wavelength λ (nm) in the predetermined wavelength band in response to a change of the gain wavelength dependence in the optical amplification section(s); and

control means for controlling each optical pumping light output from said optical pumping light ~~source(s)~~ sources so as to keep the total power of light output from said optical amplifier at predetermined level and controlling the gradient $dL/d\lambda$ of said optical filter so as to flatten the wavelength dependence of light power output from said optical amplifier.

2. (Original) An amplifier according to claim 1, wherein said optical filter satisfies

$$\approx a(\lambda - \lambda_c) + b$$

(where λ_c (nm) and b (dB) are constants) in the predetermined wavelength band and changes a (dB/nm) to adjust the gradient $dL/d\lambda$; and

λ_c and b are set constant prior to control of $dL/d\lambda$.

3. (Original) An amplifier according to claim 1, further comprising a gain equalizer for compensating for an inherent wavelength-dependent gain of said optical amplification section.

4. (Previously presented) An amplifier according to claim 1, further comprising a wave number monitor for detecting the number of signal light components contained in the multiplexed signal light, and wherein said control means maintains each light power of signal light component after amplification at a constant by controlling the power of each optical pumping light from said optical pumping light source(s) in accordance with the number of signal light components detected by said wave number monitor.

5. (Original) An amplifier according to claim 1, further comprising input light power detection means for detecting the light power input to said optical amplification section, and wherein said control means adjusts the gradient $dL/d\lambda$ of said optical filter on the basis of the detection result by said input light power detection means.

6. (Original) An amplifier according to claim 1, further comprising gain detection means for detecting a gain of said optical amplification section, and wherein said control means adjusts the gradient $dL/d\lambda$ of said optical filter on the basis of the detection result by said gain detection means.

7. (Original) An amplifier according to claim 1, further comprising detection means for detecting each wavelength and power of signal light components contained in the light output

from said optical amplification section, and wherein said control means adjusts the gradient $dL/d\lambda$ of said optical filter on the basis of power deviation between two signal light components having shortest and longest wavelengths detected by said detection means.

8. (Original) An amplifier according to claim 7, further comprising read means for reading information related to the shortest and longest wavelengths of the signal light components in the multiplexed signal light sent together with the multiplexed signal light, and wherein said control means obtains the power deviation on the basis of the information obtained by said read means.

9. (Original) An amplifier according to claim 1, further comprising ASE light level detection means for detecting an ASE light levels of the light output from said optical amplification section at each wavelengths outside two ends of the predetermined wavelength band, and wherein said control means adjusts the gradient $dL/d\lambda$ of said optical filter so that a level difference between ASE light levels detected by said ASE light level detection means becomes constant.

10. (Original) An amplifier according to claim 1, further comprising:
detection means for detecting each wavelength and power of signal light components contained in the light output from said optical amplification section; and

ASE light level detection means for detecting an ASE light levels of the light output from said optical amplification section at each wavelengths one of which is shorter than the shortest

wavelength and the other of which is longer than the longest wavelength both of which detected by said detection means, and

wherein said control means adjusts the gradient $dL/d\lambda$ of said optical filter so that a level difference between ASE light levels detected by said ASE light level detection means becomes constant.

11. (Original) An amplifier according to claim 10, further comprising read means for reading information related to the shortest and longest wavelengths of the signal light components in the multiplexed signal light sent together with the multiplexed signal light, and wherein said ASE light level detection means determines wavelengths to be detected on the basis of the information obtained by said read means.

12. (Currently amended) An amplifier according to claim 2, wherein λ_c of said optical filter is set in the predetermined wavelength band prior to control by said control means.

13. (Original) An amplifier according to claim 1, wherein said optical filter comprises:

a main optical path which guides the multiplexed signal light and is divided into first to sixth regions sequentially from an upstream side;

a first sub optical path which is arranged close to the first and third regions of the main optical path so that optical coupling of propagation light occurs, is spaced apart from the second region of the main optical path so that optical coupling of the propagation light does not occur,

and has a region corresponding to the second region of the main optical path, the region having a length different from that of the main optical path;

a second sub optical path which is arranged close to the fourth and sixth regions of the main optical path so that optical coupling of the propagation light occurs, is spaced apart from the fifth region of the main optical path so that optical coupling of the propagation light does not occur, and has a region corresponding to the fifth region of the main optical path, the region having a length different from that of the main optical path;

a first temperature adjusting device arranged in at least one of the second region of the main optical path and the region of the first sub optical path, which corresponds to the second region of the main optical path; and

a second temperature adjusting device arranged in at least one of the fifth region of the main optical path and the region of the second sub optical path, which corresponds to the fifth region of the main optical path.

14. (Currently amended) An optical amplification method of amplifying, at once, multiplexed signal light belonging to a predetermined wavelength band, in which a plurality of signal light ~~components~~ channels having different wavelengths are multiplexed, comprising the steps of:

guiding the multiplexed signal light to an optical waveguide doped with a fluorescent material together with predetermined optical pumping light and optically amplifying the multiplexed signal light;

guiding the multiplexed signal light ~~components~~ channels to an optical filter capable of changing a gradient $dL/d\lambda$ of a loss L (dB) with respect to a wavelength λ (nm) in the

predetermined wavelength band and controlling the gradient $dL/d\lambda$ of the optical filter so as to flatten the wavelength dependence of light power obtained by said optical amplifying method; and

controlling an intensity of the optical pumping light to keep the total power of multiplexed signal light obtained by said optical amplifying method at predetermined level.

15. (Original) A method according to claim 14, wherein the optical filter satisfies

$$L \approx a(\lambda - \lambda_c) + b$$

(where λ_c (nm) and b (dB) are constants) in the predetermined wavelength band and changes a (dB/nm) to adjust the gradient $dL/d\lambda$; and

λ_c and b are set constant prior to control of $dL/d\lambda$.

16. (Original) A method according to claim 14, further comprising the step of reducing an inherent wavelength-dependent gain in the optical amplification using a predetermined gain equalizer.

17. (Original) A method according to claim 14, further comprising the step of detecting the number of signal light components contained in the multiplexed signal light and adjusting the target value of light power after amplification in accordance with the detected number of signal light components.

18. (Original) a method according to claim 14, further comprising the step of adjusting the gradient $dL/d\lambda$ of the optical filter on the basis of light power of the multiplexed signal light before the optical amplification.

19. (Original) A method according to claim 14, further comprising the step of adjusting the gradient $dL/d\lambda$ of the optical filter on the basis of the gain in the optical amplification.

20. (Original) A method according to claim 14, further comprising the step of adjusting the gradient $dL/d\lambda$ of the optical filter on the basis of deviation of light power between two different wavelengths detected in the predetermined wavelength band of the light after the optical amplification.

21. (Original) A method according to claim 20, further comprising the step of reading information related to shortest and longest wavelengths of the signal light components in the multiplexed signal light components in the multiplexed signal light sent together with the multiplexed signal light, and wherein the two different wavelengths are the read shortest and longest wavelengths.

22. (Original) A method according to claim 14, further comprising detecting ASE light levels of each of wavelengths outside two ends of the predetermined wavelength band of the light after optical amplification and adjusting the gradient $dL/d\lambda$ of the optical filter so that a difference between two ASE light levels becomes constant.

23. (Original) A method according to claim 14, further comprising the step of detecting each wavelength and power of signal light components contained in the light after the optical amplification and detecting ASE light levels at each wavelengths one of which is shorter than the shortest detected wavelength and the other of which is longer than the longest detected wavelength.

24. (Original) A method according to claim 23, further comprising the step of reading information related to shortest and longest wavelengths of the signal light components in the multiplexed signal light sent together with the multiplexed signal light, and determining two wavelengths to be ASE light levels detected, on the basis of the read shortest wavelength and longest wavelength.

25. (Currently amended) A method according to claim 14 15, wherein λ_c of the optical filter is set and adjusted in the predetermined wavelength band prior to said controlling step.

26. (Original) A method according to claim 14, further comprising when a total transmittance in the predetermined wavelength band of the optical filter is adjusted to a maximum value, adjusting the loss L to be substantially constant independently of the wavelength.

27. (Original) A method according to claim 14, wherein the optical filter comprises:
a main optical path which guides the multiplexed signal light and is divided into first to sixth regions sequentially from an upstream side;

a first sub optical path which is arranged close to the first and third regions of the main optical path so that optical coupling of propagation light occurs, is spaced apart from the second region of the main optical path so that optical coupling of the propagation light does not occur, and has a region corresponding to the second region of the main optical path, the region having a length different from that of the main optical path;

a second sub optical path which is arranged close to the fourth and sixth regions of the main optical path so that optical coupling of the propagation light occurs, is spaced apart from the fifth region of the main optical path so that optical coupling of the propagation light does not occur, and has a region corresponding to the fifth region of the main optical path, the region having a length different from that of the main optical path, and

said adjusting the gradient $dL/d\lambda$ of the optical filter is achieved by adjusting at least one of a temperature in the first sub optical path and a temperature in a region of the main optical path which corresponds to the first sub optical path, and at least one of a temperature in the second sub optical path and a temperature in a region of the main optical path which corresponds to the second sub optical path.

28. (Previously presented) An amplifier according to claim 1, wherein said predetermined wavelength band has band-width not less than 20 nm.

29. (Previously presented) An optical amplifier for amplifying, at once, multiplexed signal light belonging to a predetermined wavelength band, in which a plurality of signal light components having different wavelengths are multiplexed, comprising:

one or a plurality of optical amplification sections each of which has an optical waveguide doped with a fluorescent material and amplifies the multiplexed signal light by optical pumping of the fluorescent material;

an optical pumping light source for supplying predetermined optical pumping light to said optical amplification section;

an optical filter capable of changing a gradient $dL/d\lambda$ of a loss L (dB) with respect to a wavelength λ (nm) in the predetermined wavelength band in response to change of the gain wavelength dependence in the optical amplification section(s);

a gain equalizer for compensating for an inherent wavelength-dependent gain of said optical amplification section; and

control means for controlling each optical pumping light output from said optical pumping light source(s) so as to keep the total power of light output from said optical amplifier at predetermined level and controlling the gradient $dL/d\lambda$ of said optical filter so as to flatten the wavelength dependence of light power output from said optical amplifier.

30. (Previously presented) A method according to claim 14, wherein said predetermined wavelength band has band-width not less than 20 nm.

31. (Previously presented) An optical amplification method of amplifying, at once, multiplexed signal light belonging to a predetermined wavelength band, in which a plurality of signal light components having different wavelengths are multiplexed, comprising the steps of:

guiding the multiplexed signal light to an optical waveguide doped with a fluorescent material together with predetermined optical pumping light and optically amplifying the multiplexed signal light;

guiding the multiplexed signal light components to an optical filter capable of changing a gradient $dL/d\lambda$ of a loss L (dB) with respect to a wavelength λ (nm) in the predetermined wavelength band and controlling the gradient $dL/d\lambda$ of the optical filter so as to flatten the wavelength dependence of light power obtained by said optical amplifying method;

reducing an inherent wavelength-dependent gain in the optical amplification using a predetermined gain equalizer; and

controlling an intensity of the optical pumping light to keep the total power of multiplexed signal light obtained by said optical amplifying method at predetermined level.